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DISPLACEMENT OF PRIVATELY HELD STOCKS BY PUBLIC STOCKS: A REVIEW OF EMPIRICAL STUDIES OF THE CORN AND WHEAT MARKETS

by

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Many early studies on public stockholding ignored the role of private storage (Cochrane and Danin; Reutlinger; and Subotnik and Houck, for example). However, the works of Baumes and Meyers; Gadman et al; Gallager et al; Gardner (1979, 1981); Helmberger and Akinyosoye; Helmberger and Weaver; Helmberger et al; Just; Peck; Peck and Gray; Sharples and Holland; and Zulauf have rectified this deficiency and made important contributions to understanding the interaction between public and private stockholding. Understanding this interaction is important because Gustafson and Helmberger and Weaver have shown theoretically that in a perfectly competitive economy storage by private economic agents will maximize net social welfare. Since the private storage market in the U.S. approximates perfect competition (Caves, Stein, Keeler and Smith), it is unlikely that public storage can be cost effective in increasing price stability over that provided by private storage.

Political considerations or divergence between social and private rates of return may, however, justify the accumulation of public stocks. In the U.S., public storage of agricultural commodities has often been a by-product of political concern over low farm income. In addition, almost everyone who has examined the public stocks issue has concluded that the private trade stores too little relative to social goals (Gardner, 1979). The main social benefit generally attributed to the accumulation of public stocks has been reduced price variability.

If, as the U.S. has, a society decides to accumulate public stocks, it presumably would desire that they be accumulated at minimum cost. One consideration in meeting this goal is the need to minimize the displacement of

private storage by public stocks. Therefore, in the hope of providing insights into strategies for minimizing costs associated with displacement of private stocks, this section contains a review of investigations which have estimated the displacement effect.

Overview

Farmers and/or firms store commodities because they expect prices to increase by an amount which equals or exceeds the cost of storage. In contrast, public stocks are rarely accumulated to make profits. Instead, their accumulation reflects political and/or social concerns. Despite the differences in motives, public stocks reduce the likelihood of potential price increases by increasing future supply. They therefore reduce the incentive for private storage. Consequently, public stocks will likely displace private stocks.

This following review of empirical estimates of the displacement effect will be limited to studies which examined the corn and wheat markets. Displacement of private by public storage for these commodities has received the attention of several investigators. In contrast, the displacement effect for other farm commodities has received only limited attention.

Most of the investigations reviewed (see Table 1) estimated the following general equation:

Private Stocks = f (public stocks, private incentive to store)[1]

The coefficient(s) on the public stock variable(s) represent(s) the displacement effect.

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[1] Just's model also included as an independent variable a one quarter lag on private stocks while both Just's and Gardner's model contained quarterly shift or dummy variables to remove seasonal effects.

Table 1: Displacement of Privately Held Stocks by Public Stocks: Empirical Estimates for Corn and Wheat, U.S.

Investigator(s)	Commodity	Period Studied	Type of Model	Public Stock	Displacement Value
Baumes, Meyers	Corn	1950-75	Annual	CCC[a]	-0.32^{***}
	Wheat	1951-76	Annual	CCC	-0.14^{***}
Gadson, et al.	Corn	1960-79	Annual	FOR[b]	-0.38^{**}
	Wheat	1965-80	Annual	FOR	-0.55^{***}
Gallagher, et al.	Wheat	1951-74	Annual	CCC	-0.14^{***}
Gardner (1981)	Corn	1950-78	Annual	CCC	$0.0^{***,c}$
				FOR	-0.61^{c}
	Wheat	1950-78	Annual	CCC	-0.42^{***}
				FOR	-0.74^{**}
	Corn	1972-80	Quarterly	FOR	-1.04^{c}
	Wheat	1972-80	Quarterly	FOR	-0.96^{c}
Just	Corn	-[d]	Quarterly	CCC	-[e]
		-[d]		FOR	-0.52
	Wheat	-[d]	Quarterly	CCC	-0.04^{***}
		-[d]		FOR	-0.81
Peck	Wheat	1950-74	Annual	CCC	-0.12^{***}
Sharples, Holland	Wheat	1972-78	Annual	FOR	$-0.14^{c,f}$
Zulauf	Corn	1954-74	Annual	Loan[g]	-0.01^{***}
				$(\text{Loan})^2$	-0.82^{***}
				CCC	-0.30^{*}
				$(\text{CCC})^2$	0.52
	Wheat	1954-74	Annual	Loan	-0.35^{***}
				$(\text{Loan})^2$	0.81^{***}
				CCC	-0.15^{***}
				$(\text{CCC})^2$	0.07

[a]Stocks owned by Commodity Credit Corporation.

[b]Stocks held in Farmer-Owned Reserve.

[c]The equations were estimated such that the coefficient of the public stocks variable represented the proportional addition to total stocks contributed by the public stocks. Therefore, the displacement value of private stocks by public stocks, the value presented in the table, equals the estimated coefficient minus one. The level of significance refers to the estimated coefficient, not the coefficient presented in the table.

[d]The dates covered were not reported.

[e]The coefficient was not reported, but in the text it was indicated that the coefficient was insignificant.

[f]No significance level was reported although the coefficient was apparently significant at the one percent level.

[g]Stocks held by farmers under CCC loan.

* Coefficient significantly different from zero at ten percent level.

** Coefficient significantly different from zero at five percent level.

*** Coefficient significantly different from zero at one percent level.

With exception of Just's and one component of Gardner's investigation, the studies estimated the public stock displacement of private stocks carried out of a crop year. Since private carryout represents the private trade's contribution to the upcoming crop year's supply, the displacement of private carryout represent a reduction in the private trade's contribution to stabilizing year-to-year supply and therefore price fluctuation.

Just and Gardner provide estimates of the displacement effect based on quarterly corn and wheat stocks. Their estimated coefficients therefore estimate the reduction in the private trade's contribution to stabilizing intra-year as well as inter-year price variation.

All the reviewed investigations defined private stocks as total stocks minus public stocks. Each included as public stocks, stocks owned by the Commodity Credit Corporation (CCC), the public agency charged with day-to-day operations of public price support and storage programs. Studies conducted over the most recent periods have also examined the displacement effect of grain held in the farmer-owned reserve (FOR). Began in 1977, the FOR program encourages on-farm storage by providing extended nonrecourse loans and storage subsidies to farmers. Thus, most of the studies defined private stocks as total stocks minus CCC owned stocks minus FOR stocks (if post 1977).

Zulauf included stocks held under regular nonrecourse loan and the reseal program as public stocks. The regular nonrecourse loan program provides loans of less than one year in length to farmers who pledge their crop as collateral. It is the primary price support mechanism. The reseal program, which was in effect before FOR was enacted, allowed a farmer to carry the grain for an additional period of time. The farmer was allowed

to keep the original loan with his grain as collateral and he was usually paid a storage subsidy. However, interest on the loan continued to accrue.

Zulauf argued that, once placed under loan, farmers would sell loan stocks on the private market only when market price exceeded the loan rate plus accumulated interest plus any other charges. Thus, loan stocks may or may not be directly available to the private market, a characteristic of public stocks. Thus, in Zulauf's investigation, which excluded the FOR period, private stocks were defined as total stocks minus CCC owned and loan stocks.

The displacement effect of public stocks on private stocks would be expected to be related to the degree to which public stocks are sheltered from the market. Specifically, the higher the release price of public stocks relative to the market equilibrium price, the lower the likelihood that the public stocks would be released onto the private market and therefore the lower the displacement effect. In other words, the possibility that market prices may exceed the release price decreases as the release price increases relative to the market equilibrium price.

Applying this line of argument, in the pre-FOR period loan stocks should have a larger displacement effect than CCC owned stocks. The latter's release price was set at 105 percent or more of the loan rate, and thus they were further from the market than loan stocks. In the FOR era, FOR's release price has been based on various markups of the loan rate while the release price on CCC owned stocks has always been higher than the FOR release price. Thus, displacement of private stocks should be higher for loan stocks, next highest for FOR stocks, and lowest for CCC owned stocks.

The private-incentive-to-store variable in the estimated equations was proxied by a number of different variables. Baumes and Meyers, Gadson, et al, Gallagher, et al, and Just used various combinations of current year's price, current year's production, and next year's expected or actual production to proxy expected price change, i.e., the private market's incentive to store. Gardner used only current year's supply as the proxy. He based this choice on Gustafson's finding that "when year-to-year fluctuations are due to random variation in production around a fixed mean, and demand and storage costs are constant, profit-seeking stockholding results in a storage function in which ending stocks are a function of beginning supply only" (Gardner, 1981, p. 9). Peck and Zulauf used Working's (1948, 1949) price of storage theory while Sharples used a variation of this theory. Specifically, Peck and Zulauf used the spread between old crop and new crop futures to proxy the private market storage incentive while Sharples used expected price, measured as three year moving average of past prices, minus the current price.

Summary of Empirical Findings

The value estimated for the displacement of private stocks by public stocks would be affected not only by the commodity analyzed but also by the types of public stock included in the estimated equation, the variables used to measure private market storage incentives, the period of analysis, and the characteristics of the public storage program. At least one and usually more of the latter factors varied between and among the investigations reviewed. Thus, comparison of the estimated displacement effects requires caution.

Given this caution, the estimates for the wheat market seem remarkedly consistent among the various studies. Displacement of private stocks by

CCC owned stocks in the pre-FOR period was estimated by all studies to be between -0.1 and -0.15. Each addition to CCC owned stocks therefore reduced private stocks by about one-tenth, yielding a 90 percent effective increase in total stocks. Since the FOR program was instituted, it is unclear whether the displacement effect of CCC owned stocks has increased. Gardner's study suggestes an affirmative answer while Just's study suggests a negative answer.

The results from Gadson, et al, Gardner, and Just suggest that FOR's displacement effect is substantially larger than the displacement caused by CCC owned stocks either before or after FOR was instituted. While Sharples' estimate is in sharp contrast with this conclusion, the composite evidence suggests a displacement of 0.6 to 0.8 bushel of private stocks for each addition to FOR stocks. In interpreting the FOR coefficients, it is important to keep in mind that they are based on only a few observations, three at the most for the annual models.

The greater displacement effect of FOR stocks vis-a-vis CCC owned stocks was expected given the fact that FOR stocks are closer to the market equilibrium price. Along the same lines, Zulauf found a significantly higher displacement effect for loan stocks than for CCC owned stocks over the 1954-74 period.

For corn, the pre-FOR displacement effect of CCC owned stocks appears to have been approximately 30 percent. It has also apparently declined since FOR was instituted.

The FOR displacement effect appears to be large although Just's coefficient is not statistically different from zero (displacement). Gardner's estimates suggest a displacement of -1 or 100 percent. His coefficients need to be interpreted with care. He specifically estimated

the addition to total stocks provided by FOR or CCC stocks. His estimates for FOR were a .39 addition in the annual model and -0.04 addition in his quarterly model. These results are equivalent to stating that FOR stocks have a displacement value of -0.61 or -1.04. Neither of Gardner's estimates were statistically significant. Thus, it is not possible to state that FOR stocks resulted in a net addition to total stocks. In conclusion, the studies reviewed suggest that the displacement effect of corn FOR stocks is large, with a value probably of -0.5 at a minimum. Again, this conclusion is based on very limited data.

Zulauf was the only investigator to estimate a non-linear displacement effect. Three of the four estimated coefficients for the squared terms were significantly different from zero at the ten percent level. The estimated coefficients suggest that the marginal displacement of public stocks equalled zero when CCC corn stocks equalled 28 percent of production and wheat loan stocks equalled 22 percent of production. No value was estimated for corn because the linear term was insignificant.

Conclusions

The studies reviewed almost uniformly found that public stocks have displaced private stocks in the corn and wheat markets. On the other hand, the majority of the studies found the displacement to be less than 100 percent. Thus, the public stocks programs have increased total stocks of corn and wheat and therefore probably dampened price fluctuations.

The studies also support the statement that the closer the release price is to the market equilibrium price, the greater the displacement effect. Thus, as price support and public storage programs have become more market oriented, the cost of public storage programs in terms of displaced private stocks have increased. This conclusion does not imply that

total cost of price support and public storage programs have increased but only this component of overall program costs.

The studies also contain implications for the existing econometric models used to provide information for policy makers. For example, U.S. Department of Agriculture's Farm and Agricultural Policy Simulator currently uses a displacement coefficient of -0.26 for corn FOR stocks and -0.30 for wheat FOR stocks (Price). The reviewed studies suggest that these values are too small, that loan stocks and CCC owned stocks should be identified in the model, and that the displacement effect should be nonlinear. These changes should improve the accuracy of the model and therefore the quality of information provided policy makers.

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